

**MEMORANDUM OF UNDERSTANDING**

**BETWEEN**

**THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

**OF THE UNITED STATES**

**AND**

**THE CENTRE NATIONAL D'ETUDES SPATIALES**

**OF FRANCE**

**FOR COOPERATION IN**

**THE CALIPSO MISSION**

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## **Preamble**

The National Aeronautics and Space Administration of the United States (hereinafter referred to as NASA), represented by its Administrator, and

The Centre National d'Etudes Spatiales of France (hereinafter referred to as CNES), as established under the provisions of the Law 61-1382 dated December 19, 1961, setting up a national center for space research, represented by its President,

as the Parties to this Memorandum of Understanding (MOU) (hereinafter the Parties),

CONSIDERING their cooperative effort that led to the successful TOPEX/Poseidon mission launched by an Ariane launch vehicle on August 10, 1992, and their agreement of December 20, 1996, for the Jason-1 program,

RECOGNIZING the need for a mission to collect data to understand better the role of clouds and aerosols in climate, thus improving the ability to predict long term climate change and seasonal to interannual climate variability,

CONSIDERING that such a mission could use light detection and ranging (lidar) technology and applications,

RECALLING the success of the first demonstration of the feasibility of lidar in NASA's Lidar In-Space Technology Experiment (LITE), launched on the STS-64 mission in September 1994,

CONSIDERING their common interest in developing the capacity to use a lidar instrument on a long-term basis to improve the ability to predict long term climate change,

RECALLING that a cloud and aerosol mission was recommended for Phase A study by the CNES science advisory panel (CPS) in March 1998, following the prospective scientific seminar in Arcachon, France,

RECALLING that the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission, including CNES participation, was selected for development in December 1998 by NASA's Earth Science Enterprise through its second Earth System Science Pathfinder (ESSP-2) Announcement of Opportunity (AO), and

RECALLING that in October 1999, the CNES Board of Directors endorsed CNES' participation in the CALIPSO mission,

Have agreed as follows:

## **Article I - Purpose**

This MOU sets forth the terms and conditions under which the Parties will cooperate in the CALIPSO mission.

## **Article II - Mission Description and Participation**

1. The primary objective of the CALIPSO mission is to collect cloud and aerosol data to allow a better understanding of the role of clouds and aerosols in climate and improve the ability to predict long-term climate change and seasonal to interannual climate variability. The Parties will use lidar, infrared radiometry, and visible imaging techniques to satisfy this objective.
2. A secondary objective is to provide a set of simultaneous coincident data with which to validate and improve data retrievals from NASA's Earth Observing System (EOS) Aqua mission. To satisfy this objective, CALIPSO will adapt its orbit to the EOS Aqua orbit.
3. The CloudSat mission, also selected by NASA under the ESSP-2 AO, will fly in formation with CALIPSO, so that the two satellites can simultaneously collect cloud and aerosol data. It is understood between the Parties that the CloudSat mission will adapt its orbit to the CALIPSO orbit, and that the CloudSat mission will neither create a major interference nor a major impact on the CALIPSO mission. Plans are to co-manifest CALIPSO and CloudSat for a dual launch from a U.S. launch site using a NASA-provided Delta II launch vehicle. The CALIPSO satellite will be in the upper position of the dual configuration.
4. CNES also plans to fly its Polarisation et Anisotropie des Réflectances au sommet de l'Atmosphère couplées avec un Satellite d'Observation emportant un Lidar (PARASOL) mission in formation with CALIPSO so that the two satellites can simultaneously collect cloud and aerosol data. PARASOL will adapt its orbit to the CALIPSO orbit and will neither create a major interference nor a major impact on the CALIPSO or the CloudSat mission.
5. For purposes of this MOU, the payload is defined as the module that contains the instruments, the payload onboard computer, payload data storage and telemetry system and the payload structure. The platform is defined as the structure to which the payload is attached. The flight Star Tracker Assembly (STA) is part of the platform, but is mounted onto the payload. The satellite is composed of the assembled payload and platform and is launched into space.
6. The CALIPSO mission is led by NASA. The CALIPSO satellite, integrated and tested under CNES' responsibility, will consist of a platform, designed and provided by CNES, carrying a payload, under NASA's responsibility, containing instruments to be provided by both Parties. The payload instrument complement will consist of an Infrared Imaging Radiometer (IIR), provided by CNES, and a lidar and a Wide-Field Camera (WFC) provided by NASA. Additionally, NASA will provide the storage required and a payload telemetry system to downlink the payload data, the payload onboard computer, and the payload structure. NASA will be responsible for launching the CALIPSO satellite.

7. The Level 1 Requirements document issued by NASA Headquarters describes the baseline mission as the three-channel lidar, the IIR, and the WFC, flying in formation with a broadband flux instrument and a multi-spectral radiometer--such as the Clouds and the Earth Radiant Energy System (CERES) and Moderate Resolution Imaging Spectrometer (MODIS) on Aqua and Terra--and a minimum on-orbit duration of 3 years. This baseline mission has been agreed upon by both Parties.
8. The CALIPSO mission will collect science data and products for clouds and aerosols. For purposes of this MOU, the following definitions will apply. "X-band satellite telemetry" is data as received from the payload, including sensor and housekeeping data. "Payload science data" is the portion of the X-band satellite telemetry composed of the instrument sensor data. "Science data products" are products resulting from the processing of the payload science data.
9. The CALIPSO satellite is planned to operate for a nominal period of three years. The satellite will be operated by CNES throughout the life of the mission. NASA will command and control the payload by providing payload commands to the CNES satellite control center for uplink. NASA will process X-band satellite telemetry, science data and science data products, as defined in Articles IV and XV below. The X-band satellite telemetry, science data and science data products, as required, will be made available to CNES in a timely manner. There may be satellite expendables remaining at the end of the nominal three-year mission and after a reserve for end-of-life disposal has been established. Any residual expendables, above that required to support disposal, can be used to provide extended satellite operations should the Parties decide to support such extension of the CALIPSO mission. After end of mission, the satellite will be passivated and disposed of in accordance with established NASA and CNES procedures as documented in the CALIPSO Project Plan.
10. Payload science data and science data products will be made available to the CALIPSO science team and the broader international user community according to Article XV below.

### **Article III - CNES Responsibilities**

To implement this cooperative project, CNES, in accordance with the detailed provisions of the CALIPSO Project Plan to be developed by the Parties and defined in Article VII, will use reasonable efforts to:

1. Support the overall systems engineering function for the CALIPSO mission, including support in developing overall system specifications and overall Interface Control Documents (ICDs) which define the NASA/CNES interfaces;
2. Provide satellite engineering, develop a satellite specification document and establish requirements for overall satellite level testing, plan and conduct satellite level tests, evaluate test results, certify satellite flight readiness and provide a Payload Design Interface Specification (PDIS) between the platform and the payload;

3. Design, fabricate, assemble, test and calibrate the IIR, provide an IIR simulator for payload interface verification, transport the IIR and IIR simulator to the NASA-designated integration site, and support integration of the IIR onto the payload;
4. Design, fabricate and test the CALIPSO platform (PROTEUS), including the flight STA;
5. Design, fabricate, and transport a mass model of the STA and the STA's flight wire harness to the NASA-designated site;
6. Integrate the payload onto the CALIPSO platform, perform functional and environmental testing, transport the integrated CALIPSO satellite to the NASA-designated launch site in the U.S. and support launch site processing, as detailed in the CALIPSO Project Plan;
7. Support end-to-end system level testing by performing functional tests of the satellite, including assistance with testing of the payload data telemetry system with NASA-provided ground control and data archival centers;
8. Provide ground support equipment and qualified personnel at appropriate sites to support payload and system integration, testing, launch and operations;
9. Provide NASA with all satellite requirements and constraints necessary for satellite launch, and satisfy all launch vehicle requirements and constraints (e.g., safety requirements) unless formally waived;
10. Perform checkout of the CALIPSO satellite during the launch campaign;
11. Operate the satellite, as required, until the end of the in-flight check-out phase, and operate the satellite on a nominal work week schedule during the routine phase;
12. Design, fabricate, and test the Satellite Operations Ground System (SOGS) which includes the Satellite Operations Control Center (SOCC), based on the PROTEUS Generic Ground Segment (PGGS), the data communication network and the TM/TC Earth terminal (TTCET);
13. Receive and provide to NASA S-band data related to the payload and satellite, as specified in the CALIPSO Project Plan;
14. Perform system level testing between the satellite and the SOGS. This system level testing will also include joint testing with the NASA-provided Payload Operations Control Center (POCC);
15. Perform evaluation and calibration activities, as required and mutually agreed, after launch and according to a schedule defined in the CALIPSO Project Plan, to verify the performance achieved on-orbit by the IIR, and provide results to NASA. Perform analysis and validation of IIR telemetry data during the overall mission, with the assistance of the Institut Pierre Simon LaPlace (IPSL), as required;

16. Develop, with the support of IPSL, IIR science data processing algorithms and test cases for coding and implementation by NASA in its Distributed Active Archive Center (DAAC);
17. Arrange with the appropriate French research organizations to support and prepare the French members of the science teams, French scientists and French users to analyze and validate CALIPSO payload science data and science data products and publish their findings in accordance with Articles VI, XV and XVI below; in particular, in archiving and/or making available, as appropriate, CALIPSO science data products to the scientific community;
18. Arrange with the appropriate French research organizations to support IPSL in processing existing payload science data and science data products;
19. Define and implement the French component of the CALIPSO outreach program; and
20. Inform NASA promptly of any technical or programmatic problems, which may affect overall CALIPSO mission schedules, cost or performance.

#### **Article IV - NASA Responsibilities**

To implement this cooperative project, NASA, in accordance with the detailed provisions of the CALIPSO Project Plan to be developed by the Parties and defined in Article VII, will use reasonable efforts to:

1. Provide system engineering, develop overall system specifications and overall ICDs which will define the NASA/CNES interfaces, including support of the payload/platform ICD that demonstrates compliance to the PDIS;
2. Provide requirements for overall payload level testing, the planning and conduct of payload system level tests, evaluation of test results and certification of flight readiness;
3. Design, fabricate, assemble and test the payload onboard computer, payload storage and telemetry system and the payload structure;
4. Design, fabricate, test, and calibrate the NASA instruments, consisting of a lidar and a WFC;
5. Provide the information on interfaces of the payload to the IIR;
6. Provide specifications for the Payload Numerical Simulator for incorporation into the CNES PROTEUS Engineering Simulator Test and Operations (PRESTO) bench;
7. Provide attachment fittings on the payload for mounting the CNES-provided STA and integrate the STA flight wire harness;
8. Assemble, integrate, and test the CALIPSO payload;

9. Design, fabricate and test the NASA-provided ground system, the DAAC, the POCC, the Mission Operations Control Center (MOCC) and the Payload Data Delivery System (PDDS);
10. Perform end-to-end system level testing, including system level testing between the payload data telemetry system and the NASA-provided ground system;
11. Transport the payload to the CNES-designated site, in preparation for satellite integration;
12. Provide ground support equipment including a payload simulator and qualified personnel at appropriate sites to support satellite and system integration, testing, launch and operations;
13. Provide launch services for the CALIPSO satellite which are compatible with PROTEUS capabilities and support CNES' check-out of the CALIPSO satellite during the early operations phase (in-flight check-out phase);
14. Provide CNES with all necessary launch vehicle information as defined in the CALIPSO Project Plan and support CNES in verification of the compatibility of satellite/launch vehicle interfaces;
15. Manage the launch campaign, including launch vehicle integration and pre-launch testing;
16. Perform payload operations and mission management;
17. Perform evaluation and calibration activities, as required and mutually agreed, after launch and according to a schedule defined in the CALIPSO Project Plan, to verify the performance achieved on-orbit by the lidar and WFC, and provide results to CNES;
18. Receive, process and archive X-band satellite telemetry and make X-band satellite telemetry, payload science data and science data products available to CNES via the MOCC, POCC, and DAAC, as required, in a timely manner and in accordance with Article XV;
19. Develop, code and implement in the DAAC, the lidar and WFC science data processing algorithms, and code and implement in the DAAC, the IIR algorithms developed by CNES and deliver the operational code to CNES;
20. Support the U.S. science team members in analyzing and validating CALIPSO payload science data and science data products and in publishing their findings, in accordance with Articles VI, XV and XVI below;
21. Define and implement the U.S. component of the CALIPSO outreach program; and
22. Inform CNES promptly of any technical or programmatic problems, which may affect overall CALIPSO schedules, cost, or performance.



## **Article V - Project and Program Management**

1. A CALIPSO Joint Steering Group (JSG) will be established to provide implementation oversight for the mission. The CALIPSO JSG will be composed of senior level NASA and CNES representatives involved in the development of the CALIPSO mission. The JSG will review project implementation status, resolve implementation conflicts, and provide institutional resources to ensure timely delivery of mission elements.
2. The NASA CALIPSO Principal Investigator (PI) will be responsible for overall mission success. The PI will be supported by a Co-PI from Hampton University and a Co-PI from IPSL. Consistent with the guidelines of the NASA Earth System Science Pathfinder program, the CALIPSO Principal Investigator (PI) has delegated mission implementation responsibility to the CALIPSO Mission Management Team (MMT). The CALIPSO MMT will provide end-to-end mission planning and day-to-day management, and will serve as an interface to the JSG. The MMT will be composed of the NASA CALIPSO Project Manager, the NASA CALIPSO Mission Manager, and the CNES Deputy CALIPSO Project Manager.

## **Article VI - Science Team and International Science Advisory Panel**

### **1. Science Team**

The science team, formed by the NASA CALIPSO PI, will be responsible for the science management of the CALIPSO mission. The Co-PIs from Hampton University and IPSL are members of the science team. The science team may also include other U.S. and non-U.S. scientists, including scientists selected by CNES. Proposed science team members will be agreed to by the PI and Co-PIs and approved by the NASA Associate Administrator for Earth Science.

The CALIPSO science team will be the principal scientific forum for instrument oversight, algorithm development, validation of science data, and initial science data evaluation studies. Additionally, the science team may select scientists with an expertise in the area, to perform science data evaluation. The Parties reserve the right to establish guest investigator programs for validation and science data evaluation studies.

The CALIPSO PI, supported by the Co-PIs, will be responsible for the development of the scientific aspects of CALIPSO and for assuring that the science data products are effectively used and that the results are expeditiously produced and made available, according to Article XV below. They will also be responsible for coordinating science requirements, plans and field experiments with other organizations.

### **2. International Science Advisory Panel (ISAP)**

An ISAP, headed by the Co-PI from Hampton University will be established to provide advice on the science goals of the CALIPSO program, provide an independent assessment of its scientific progress, expand the usefulness and application of its science data products, and provide a vehicle for broad international collaboration. The ISAP will be composed of four to seven eminent

atmospheric scientists, who will represent the CALIPSO data user community and who will be selected by the Co-PI from Hampton University, in consultation with the NASA CALIPSO PI and the Co-PI from IPSL.

## **Article VII - Project Plan**

1. The NASA CALIPSO Project Manager will prepare, in close coordination with the CNES Deputy Project Manager, a CALIPSO Project Plan, which will then be subject to approval by the Parties. In case of conflict between the CALIPSO Project Plan and this MOU, the MOU will prevail. This plan will detail how this cooperative project will be carried out, including mission planning, provision of the satellite, instruments and ground systems, description of interfaces, conduct of mission operations (including end of mission disposal) and data delivery, overall delivery schedule, plan for formal and informal reviews, process and configuration control, delivery timelines for X-band satellite telemetry, payload science data and science data products, and other such information as the NASA CALIPSO Project Manager and CNES Deputy Project Manager deem necessary for project control.
2. To ensure mission success, NASA and CNES will provide mutual insight into the elements under their respective responsibility, consistent with Article XIII of this MOU. Details of the insight to be provided will be described in the Project Plan.
3. Meetings and reviews required to carry out the responsibilities set forth in this MOU will also be included in the CALIPSO Project Plan, and will be held periodically in the United States, France and at other sites as mutually agreed. The schedule, scope and responsibilities of technical and programmatic reviews will be defined in the CALIPSO Project Plan. These reviews will be chaired by NASA and/or CNES, as appropriate. The Parties agree to always invite each other to these meetings and reviews.
4. The Parties will use reasonable efforts to carry out their respective responsibilities in accordance with the schedules to be defined in the CALIPSO Project Plan, and to avoid changes that will have a negative effect on the other Party with regard to scientific return, implementation approach, cost, and/or schedule, and where they cannot be avoided, to minimize these negative effects. To the extent that changes made by NASA or CNES to the CALIPSO Project Plan cause schedule, or other problems that go beyond either Party's program constraints, the MMT will discuss potential options to address such problems, and submit their proposals to the JSG for approval.

## **Article VIII – Mission Reviews, Integration and Flight Readiness**

1. To implement the CALIPSO mission, there will be a series of mission reviews to evaluate the readiness of the flight and ground segments to proceed to implementation, integration, test, and final launch preparation. Representatives from both Parties will serve on the boards of these reviews. Both Parties will furnish engineering and programmatic data and will participate in

these mission reviews, as mutually agreed. All mission review details will be included in the CALIPSO Project Plan.

2. NASA and CNES will jointly:

Make a final determination of the overall readiness to proceed with integration of the platform and the payload;

Make a final determination on the readiness of the satellite for integration with the launch vehicle; and

Make a final determination of the overall readiness of the CALIPSO satellite for launch.

### **Article IX - Exchange of Personnel**

To facilitate coordination related to the CALIPSO mission, the Parties will support the exchange of a limited number of liaisons from each Party, at a time and under conditions as mutually agreed by the NASA CALIPSO Project Manager and CNES Deputy Project Manager pursuant to necessary administrative authorizations. In the event of such an exchange, the Parties each will provide necessary office space and administrative support at the host location, including such additional support services as may be agreed by the NASA CALIPSO Project Manager and CNES Deputy Project Manager. Salary and all other personnel expenses, living and travel expenses, will be borne by the employing Party of the liaison(s) throughout the duration of their assignment.

### **Article X - Funding**

Each Party will bear the costs of discharging its respective responsibilities under this MOU, including travel and subsistence of each Party's personnel and transportation of its own equipment and associated documentation. The obligations of the Parties under this MOU are subject to their respective funding procedures and the availability of appropriated funds.

### **Article XI - Customs and Taxes**

Each Party will use reasonable efforts to arrange free customs clearance and waiver of applicable duties and taxes for equipment and related goods necessary for the implementation of this MOU. Such arrangements will be fully reciprocal. In the event that any customs fees and/or taxes of any kind are still levied on the equipment and related goods for implementation of this MOU, after seeking to develop the necessary free customs clearance and waiver of applicable duties and taxes, such customs fees and/or taxes will be borne by the Party of the country levying the fees and/or taxes.

## **Article XII - Ownership of Elements and Equipment**

For the purposes of this MOU, each Party will retain ownership of elements and equipment it furnishes to the other Party. Any equipment not launched into space will be returned to the furnishing Party at such time as mutually agreed. Each Party will transport its equipment to the designated delivery points, as specified in the CALIPSO Project Plan, and, where appropriate, from such delivery points, when the equipment is to be returned to the furnishing Party.

## **Article XIII - Exchange of Technical Data and Goods**

The Parties are obligated to transfer only those technical data (including software) and goods necessary to fulfill their respective responsibilities under this MOU, in accordance with the following provisions:

1. The transfer of technical data for the purpose of discharging the Parties' responsibilities with regard to interface, integration, and safety will normally be made without restriction, except as required by national laws and regulations relating to export control or the control of classified data. If design, manufacturing, and processing data, and associated software, which is proprietary but not export controlled, is necessary for interface, integration, or safety purposes, the transfer will be made and the data and associated software will be appropriately marked. Nothing in this article requires the Parties to transfer goods or technical data contrary to national laws and regulations relating to export control or control of classified data.
2. All transfers of proprietary technical data and export-controlled goods and technical data are subject to the following provisions. In the event a Party finds it necessary to transfer goods which are subject to export control or technical data which is proprietary or subject to export controls, and for which protection is to be maintained, such goods will be specifically identified and such technical data will be marked with a notice to indicate that they will be used and disclosed by the receiving Party and its related entities (e.g., contractors and subcontractors) only for the purposes of fulfilling the receiving Party's responsibilities under the programs implemented by this MOU and that the identified goods and marked technical data will not be disclosed or retransferred to any other entity without the prior written permission of the furnishing Party. The receiving Party agrees to abide by the terms of the notice, and to protect any such identified goods and marked technical data from unauthorized use and disclosure, and also agrees to obtain these same obligations from its related entities prior to the transfer.
3. All goods, marked proprietary data, and marked or unmarked technical data subject to export control, which are transferred under this MOU, will be used by the receiving Party exclusively for the purposes of the programs implemented by this MOU.

#### **Article XIV - Invention, Patent and Intellectual Property Rights**

1. In the event that an invention is jointly made by employees of the Parties, their contractors or subcontractors, during the implementation of this agreement, the Parties will consult and agree as to the responsibilities and costs of actions to be taken to establish and maintain patent protection for such invention and on the terms and conditions of any license or other rights to be exchanged or granted by or between the Parties.
2. Nothing in this MOU will be construed as granting or implying any rights to, or interest in, patents owned or inventions which are independently developed by the Parties or their contractors or subcontractors.

#### **Article XV – Science Data Policy**

Access to CALIPSO science data will be as follows:

1. In all cases, the Parties will provide immediate access to all CALIPSO payload science data and science data products, free of charge, for members of the science team, as well as designated representatives of science team members, including associates, staff and co-workers. The Parties will also provide free of charge, payload science data and science data products necessary to the scientists selected for validation.
2. NASA has the responsibility to make science data products available to the public and the science community in a Hierarchical Data Format (HDF)-standard data format after the appropriate science calibration and validation, at no more than the cost of fulfilling the user request. In order to promote rapid access to science data products, some preliminary science data products will be archived after initial verification, but prior to full validation, and made available to all users at no more than the cost of fulfilling the user request.
3. All X-band satellite telemetry, payload science data and science data products obtained from the CALIPSO mission will be archived in appropriate NASA data centers as defined in the CALIPSO Project Plan. Copies of the CALIPSO science data products will be exchanged between the Parties.
4. The CALIPSO science team members (including designated representatives) and scientists selected for validation must provide a report to the Parties on the results of their analysis and validation investigations.
5. All users, including the CALIPSO science team members and scientists selected for validation, should provide a report to the Parties on the results of their investigations on validated CALIPSO science data.
6. Notwithstanding any termination of this MOU by either Party, any X-band satellite telemetry and science data products obtained from the CALIPSO mission, as defined in the

CALIPSO Project Plan, will be archived by NASA for at least 10 years after completion of the CALIPSO mission, unless otherwise agreed by the Parties.

7. The Parties will provide mutual access to science data products from their separate, but related missions, EOS-Aqua, CloudSat and PARASOL. The Parties will agree on the terms of data access. If deemed of interest for scientific analysis of CALIPSO data, the Parties may agree to provide mutual access to correlative data products from other missions.
8. To enhance scientific analysis of CALIPSO data, coordinated Announcements of Opportunity may be issued by the Parties.

#### **Article XVI - Publication of Public Information and Results**

The Parties retain the right to release public information regarding their own activities under this MOU. The Parties will coordinate with each other in advance concerning public information activities, which relate to the other Party's responsibilities or performance under this MOU.

The analyzed results obtained from the CALIPSO mission will be made available to the general scientific community through publication in appropriate journals or presentations at scientific conferences as soon as possible and consistent with good scientific practices. In the event that such reports or publications are copyrighted, the Parties will have a royalty free right under the copyright to reproduce, distribute and use such copyrighted work for their own purposes.

In the event a Party or its investigators publish results primarily obtained from CALIPSO science data, or other information regarding results obtained from the implementation of this MOU, the Party or its investigators involved with the publication will make this information available to the other Party, and each Party will, at minimum, have a royalty free right to reproduce, use, and distribute the publication for its own purposes.

In no event will a Party include in a publication export controlled or proprietary technical data or information on technical goods furnished by the other Party, in accordance with Article XIII of this MOU, or information disclosing the other Party's inventions before patent application, without the other Party's prior written consent.

#### **Article XVII - Liability**

(a) The purpose of this Article is to establish a cross-waiver of liability between the Parties and their related entities in the interest of encouraging participation in the exploration, exploitation, and use of outer space. This cross-waiver of liability will be broadly construed to achieve this objective.

(b) As used in this cross-waiver,

(1) the term "Related Entity" means:

- (i) a contractor or subcontractor of a Party at any tier;
  - (ii) a user or customer of a Party at any tier; or
  - (iii) a contractor or subcontractor of a user or customer of a Party at any tier.
- "Contractors" and "subcontractors" include suppliers of any kind.

(2) the term "damage" means:

- (i) bodily injury to, or other impairment of health of, or death of, any person;
- (ii) damage to, loss of, or loss of use of any property;
- (iii) loss of revenue or profits; or
- (iv) other direct, indirect, or consequential damage.

(3) The term "payload" means any property to be flown or used on or in the launch vehicle.

(4) The term "launch vehicle" means an object or any part thereof intended for launch, launched from Earth, or returning to Earth which carries payloads or persons, or both.

(5) The term "Protected Space Operations" means all launch vehicle and payload activities on Earth, in outer space, or in transit between Earth and outer space done in implementation of this MOU. Protected Space Operations begins upon entry into force of this MOU and ends when all activities done in implementation of this MOU are completed. It includes, but is not limited to:

- (i) research, design, development, test, manufacture, assembly, integration, operation, disposal, or use of launch or transfer vehicles, payloads, or instruments, as well as related support equipment and facilities and services;
- (ii) all activities related to ground support, test, training, simulation, or guidance and control equipment and related facilities or services. "Protected Space Operations" excludes activities on Earth which are conducted on return from space to develop further a payload's product or process for use other than for launch vehicle-related activities necessary to complete implementation of this MOU.

(c) (1) Each Party agrees to a cross-waiver of liability pursuant to which each Party waives all claims against any of the entities or persons listed in sub-paragraphs (c)(1)(i) through (c)(1)(iii) of this section based on damage arising out of Protected Space Operations. This cross-waiver will apply only if the person, entity, or property causing the damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations. The cross-waiver will apply to any claims for damage, whatever the legal basis for such claims, against:

- (i) the other Party;
- (ii) a related entity of the other Party;
- (iii) the employees of any of the entities identified in sub-paragraphs (i) and (ii) above.

(2) In addition, each Party will extend the cross-waiver of liability as set forth in paragraph (c)(1) of this section to its own related entities by requiring them, by contract or otherwise, to agree to waive all claims against the entities or persons identified in sub-paragraphs (c)(1)(i) through (c)(1)(iii) of this section.

(3) For avoidance of doubt, this cross-waiver of liability includes a cross-waiver of liability arising from the Convention on International Liability for Damage Caused by Space Objects of March 29, 1972, where the person, entity, or property causing the damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations.

(4) Notwithstanding the other provisions of this Article, this cross-waiver of liability will not be applicable to the following:

- (i) claims between a Party and its own related entity or between its own related entities;
- (ii) claims made by a natural person, his/her estate, survivors, or subrogees for bodily injury, other impairment of health or death of such natural person, except where the subrogee is a Party to this MOU or has otherwise agreed to be bound by the promises of this cross-waiver;
- (iii) claims for damage caused by willful misconduct;
- (iv) intellectual property claims;
- (v) contract claims between the Parties based on the express contractual provisions of this MOU; or
- (vi) claims for damage based on a failure of the Parties or their related entities to flow down the cross-waiver.

(5) Nothing in this Article will be construed to create the basis for a claim or suit where none would otherwise exist.

#### **Article XVIII- Registration of Space Objects**

CNES will request that the Government of France register the CALIPSO satellite as a space object in accordance with the Convention on Registration of Space Objects Launched into Outer Space of January 14, 1975. Registration pursuant to this section will not affect the rights or obligations of either Party or its Government under the 1972 Convention on International Liability for Damage Caused by Space Objects.



## Article XIX – Settlement of Disputes

Any dispute not settled through the mechanisms provided in Article V, or any other issue concerning the interpretation or implementation of the terms of this MOU that cannot be resolved otherwise, will be referred to the appropriate level of management of the Parties for consideration and action.

## Article XX - Entry into Force, Duration, Amendment and Termination


This MOU will enter into force upon signature and remain in force until five years after the CALIPSO satellite has been launched. This MOU may be amended and extended by written agreement of the Parties. Either Party may terminate this MOU at any time upon twelve months written notice to the other Party. In that event, the Parties will endeavor to reach agreement on terms and conditions to minimize negative impacts of such termination on other Parties.

Termination of this MOU will not affect a Party's continuing obligations under Articles V, XIII, XIV, XV, XVI, and XVII of this agreement concerning Project and Program Management; Exchange of Technical Data and Goods; Invention, Patent and Intellectual Property Rights; Science Data Policy; Publication of Public Information and Results; and Liability, unless otherwise agreed by the Parties.

Done, in duplicate, in the English and French languages, both texts being equally authentic.

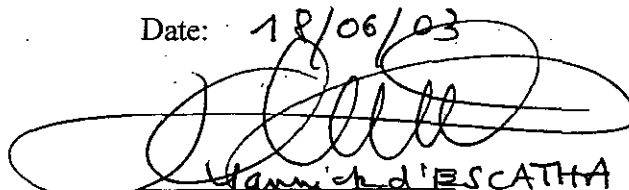
Signed at: *Paris, France*

Date: *June 18, 2003*

  
FOR THE NATIONAL  
AERONAUTICS AND  
SPACE ADMINISTRATION  
OF THE UNITED STATES

Signed at: *PARIS, FRANCE*

Date: *18/06/03*

  
FOR THE CENTRE  
NATIONAL D'ETUDES  
SPATIALES OF FRANCE